The Bare Bones of Concussion: What the Sideline Orthopaedic Surgeon Needs to Know

Michael A. Beasley, MD1 and Christina L. Master, MD2

1Division of Sports Medicine, Boston Children’s Hospital, Boston MA; 2Division of Orthopaedics, Children’s Hospital of Philadelphia, Philadelphia, PA

Abstract:
Concussions have become one of the highest profile and most controversial injuries in sport with scrutiny by athletes and their families, coaches, medical personnel, and the media dramatically increasing in recent years. With growing awareness and knowledge of concussion, assessment has progressed from minimal on-field examination and rapid return to play, to extensive on- and off-the-field comprehensive physical and neurologic examinations, computerized neurocognitive testing, advanced oculovestibular evaluations, and individualized return-to-play protocols. Orthopaedic surgeons covering sporting events as team physicians are expected to have competency in recognizing mechanisms of concussive injury, participate in on-field assessments, and contribute to the initial management and return-to-play protocols of athletes. Having an awareness of concussion epidemiology, available diagnostic testing, possible complications associated with repetitive concussions, and local legislation involving concussed athletes will prepare the team physician-surgeon to be a critical contributing member of the medical team.

Key Concepts:
- Concussion is a common injury in sport with variable presentation requiring a multidisciplinary team for assessment, diagnosis, and management.
- Concussion is primarily a functional neurologic injury rarely requiring structural imaging.
- Validated assessment tools for concussion have been developed that, while not designed to diagnose or rule out concussion as stand-alone tools, assist in the initial evaluation of an injured athlete.
- Athletes suspected of or diagnosed with concussion may not return to play on the day of injury and must undergo a formalized return to play protocol: “When in doubt, sit them out.”
- Sideline orthopaedic surgeons should be aware of initial recognition and management of concussion, as well as the potential for prolonged recovery.

Defining Concussion
The definition and components of concussion have continued to evolve and to date there is no universally accepted definition. The Concussion in Sport Group (CISG) has developed and refined a definition of sport-related concussion (SRC) since 2000, including a recent systematic review of literature including diagnostic criteria.1 The current operational definition recognizes concussion as a biomechanical trauma-induced brain injury with common features including:1
• Direct or transmitted forces to the head and neck
• Neurologic impairment typically rapid in onset after injury but may be delayed
• Signs and symptoms primarily represent a functional rather than structural injury
• Clinical symptoms typically follow a sequential course of improvement though prolonged recovery is possible
• Clinical profile should not be explained by coexisting medical conditions, medications, drug use, or other injuries

Evaluation modalities and tools have been developed that greatly assist in identifying concussion, but no stand-alone modality for diagnosis exists without the incorporation of clinical judgement. Dozens of grading scales have been published, often related to loss of consciousness or symptom severity, but none have been scientifically validated. As such, no current grading scales or classification schemes are recommended for concussion. Instead, individualized assessment for clinical resolution is relied upon.2

Concussion pathophysiology remains incompletely understood. Animal models suggest a complex neurometabolic cascade resulting from forces impacting the brain, creating a traction injury to neuronal cell membranes.3 Resultant alterations of intracellular ion concentrations, unregulated neurotransmitter release, and mitochondrial dysfunction lead to elevated reactive oxygen species production.4 Resolving the sodium-potassium imbalance requires increased glucose utilization but cerebral blood flow appears to concomitantly decrease secondary to injury, creating an energy crisis.3,4 The subsequent hypometabolic state may persist for weeks, leaving the brain vulnerable to additional insult that may worsen these metabolic changes and perhaps create more significant injury.3,5

Epidemiology
Concussions are common and increasing significantly in reported incidence with growing awareness of the injury.6 Across all age groups, up to 3.8 million concussions occur per year in sports and recreational activities with 1.0–1.8 million occurring annually in athletes ages 18 years and below, 400,000 of which occur annually in high school sports.3,5,7 Variable definitions and diagnostic criteria, incomplete surveillance, and underreporting all make accurate tracking of concussion difficult. Entry points into the medical system also continue to change as primary care providers (PCPs) become more comfortable in managing concussions. After years of increase, rates of emergency department (ED) visits for concussion have recently decreased dramatically—a 32% decrease across all ages 2012–2018 and 5–8% in ages 10–17 annually since 2013.8 In ages 5 to 17 years, as many as 80% of sport-related concussions now enter care through their PCP.9 Despite the growing concern and awareness surrounding concussion, underreporting and not seeking medical care continue to complicate tracking true epidemiology. Over 40% of adults and 45–65% of pediatric patients are not formally seen in healthcare settings.7,10 Fueled primarily by fear of losing playing time, not wanting to “let the team down,” and thinking their injury isn’t “significant enough” to require medical attention, up to 55% of high school athletes do not report concussive injuries.10

In high school sports, concussions are typically tracked by injury per athlete exposures (AEs), which represents participation in a single game or practice. In male sports, concussion occurs most frequently in American football, with lacrosse, ice hockey, and wrestling all being high risk. In female sports, soccer is highest, followed by lacrosse, field hockey, and basketball.5 In sports played similarly between sexes (i.e., basketball and soccer), females appear to have a higher risk of injury than males.5,11 Though total numbers of concussions are higher during practice, the risk of concussion remains 3–7 times higher in competition in males and 5 times higher in females.5,12

On-the-Field Assessment
While concussion injuries can be subtle and difficult to detect, some injuries involve a “downed player” requiring assessment on the playing surface. In the setting of an
unconscious player, the initial evaluation is aimed at excluding the need for emergency management. This primary survey includes assessing the “ABCs”—airway, breathing, and circulation. Asking the player a simple question such as their name, can assess consciousness and the ability to speak and protect their airway. The unconscious or nonresponsive player must be assumed to have an associated cervical spine injury requiring cervical stabilization and transport to an emergency medical facility. Any mouth guard and/or facemask should be removed to maintain access to the airway while stabilizing the neck. Remaining equipment including helmet and shoulder pads should either remain in place or be removed only if a team is present with the ability to remove while maintaining stability to the cervical spine. The team physician should regularly rehearse these scenarios with the other members of the medical team to ensure familiarity with the emergency action plan (EAP) and the tools and procedures needed to maintain player safety.

Once emergent injury is ruled out, the player should be transferred to the sideline or if available, a separate quiet location for further concussion assessment.

**Sideline Assessment**

A primary goal of the sideline concussion evaluation is to prevent a concussed athlete from returning to play and putting themselves at risk for further injury. Severe symptoms including loss of consciousness (LOC), post-injury tonic/clonic activity, motor instability, tonic posturing, confusion, or amnesia may indicate a more significant neurologic injury and require immediate removal from play. If emergency injury is ruled out but concussion diagnosis is clear, the player is removed from play, additional concussion screening/evaluation may not be necessary, and the athlete cannot be returned that same day, even if symptoms resolve. As signs and symptoms have potential to worsen, the athlete should continue to be monitored. If symptoms progress, including worsening headache, declining mental status, or repeated emesis, the athlete should be transferred to an emergency medical facility to exclude structural head injury (e.g., intracranial hemorrhage) potentially requiring surgical intervention.

Many standardized screening tools have been developed specifically for sideline concussion evaluation. Though concussion remains a clinical diagnosis and no single tool can definitively diagnose or exclude concussion, these screening tools allow for a repeatable, comprehensive approach to evaluation. Perhaps the most validated concussion screening tool is the Sport Concussion Assessment Tool (SCAT). The Concussion in Sport Group has assessed this tool at each international meeting with the SCAT5 representing the most recent revision. In addition to the SCAT5 designed for ages 13 and up, the Child SCAT5 is a similar tool designed to screen children 5 to 12 years. (See appendix for SCAT5 and Child SCAT5 forms.)

The SCAT5 begins with the critical initial observable signs such as lying motionless, balance difficulty, and confusion, as well as red flags, including neck pain or weakness, visual changes, seizure or convulsion, LOC, vomiting, or agitation/combativeness. Additional early assessment components of the SCAT5 include a memory assessment, the Glasgow Coma Scale (GCS), and cervical spine assessment. Symptom evaluation with the post-concussion symptom scale (Table 1) is followed by cognitive screening with the Standardized Assessment of Concussion (SAC), and balance assessment with the modified Balance Error Scoring System (mBEES). Baseline or pre-season scores may help with interpreting post-injury performance on the SCAT5 but is not required for use.

Though the components of the SCAT5 are individually validated, the screening comes with limitations. The SCAT5 is designed to be performed only by a physician or licensed healthcare professional with knowledge and experience with the tool and concussion assessment. Athletic Trainers (ATs) are invaluable members of the medical team in assisting with these assessments. Designed specifically for initial screening, the SCAT components appear to lose discriminative utility after 3–5
days. The CISG expert panel notes by consensus that the SCAT5 cannot be adequately performed in less than 10 minutes. In addition, it is recommended the athlete be at a resting state, so additional time may be needed after a player is removed from competition or practice before beginning. As the importance of appropriate concussion screening is increasingly recognized, sport organizations at all levels are adapting rules to permit temporary substitutions, allowing for appropriate evaluation. Normative data for the SCAT tools are limited primarily to North America and additional research is needed on its use in athletes across different cultures and language groups as well as athletes with disabilities.

Additional tools to aid in concussion evaluation continue to be developed. As visual and balance deficits are increasingly recognized in concussion, they have become a focus for assessment. The King-Devick test, a clinical test for eye movement and basic visual processing, has been adapted for use in concussion (Figure 1). The Vestibular/Oculomotor Screen (VOMS) assesses ability to perform visual movements and symptom provocation with these movements (Figure 2).

Any suspicion of concussion warrants removal from ongoing participation pending further evaluation: “When in doubt, sit them out.” If, after clinical evaluation, the athlete does not appear to have a concussion, they may be considered eligible for return to play, but as symptoms may evolve, the athlete should continue to be re-evaluated during and after play to ensure no new or worsening signs or symptoms of concussion emerge.

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>No Symptoms</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Pressure in head</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Neck pain</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Dizziness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Balance problems</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to light</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to noise</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling slowed down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling “in a fog”</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>“Don’t feel right”</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty remembering</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fatigue/low energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Confusion</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>More emotional</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Irritability</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sadness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nervous or anxious</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Trouble falling asleep</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

The symptom checklist should be completed by the athlete ranking the severity of their own symptoms on a 0 to 6 scale, ideally in a resting state. Number of symptoms and total symptom score can be tracked through follow-up visits to monitor progress.
Advanced Diagnostics
Concussion remains a diagnostic challenge, often complicated by nonspecific symptom profiles that can easily overlap with other associated injuries, adjustment reactions, and exacerbation of preexisting conditions, including headache, mood, and learning disorders. With prolonged or severe symptoms, it may be beneficial in individual cases to pursue advanced diagnostic tools.

Neuroimaging
With focal neurologic deficits, prolonged loss of consciousness, or progressively worsening symptoms, conventional neuroimaging with computed tomography (CT) may be appropriate to evaluate for structural injury such as skull fractures and intracranial bleeding. Neuroimaging is otherwise rarely indicated in the evaluation of sport-related concussion. With complex or prolonged symptoms, magnetic resonance imaging (MRI) is superior to CT in identifying white matter injury or cerebral contusion and is the preferred imaging modality. As concussion is primarily a disorder of function, even patients with persistent symptoms are only found to have structural changes attributable to their injury approximately 0.5% of the time, though more than 14% may have unrelated, predominately benign findings.

Neurocognitive Testing
Streamlined computerized neurocognitive testing has become increasingly available and utilized in high school, collegiate, and professional sports. Allowing rapid, uniform, standardized testing, these tests have potential as a baseline assessment and for following improvement after injury. While these evaluations may be helpful as part of a comprehensive evaluation, they are not adequate to be used as a stand-alone tool for diagnosis of, or clearance from, a concussion and should be interpreted by a licensed neuropsychologist or provider with experience in their use. Sleep quality, underlying conditions, testing effort, testing environment, and prior test exposure are all factors outside concussion that may affect baseline and post-injury scores. While recognized as a helpful aid in diagnosis, computerized neurocognitive testing is not currently considered a mandatory component for treatment of sport-related concussion.

Future Considerations
Sideline video review, helmet-based impact measurement devices, and app-based measurement of eye tracking, balance, and reaction time all have potential to aid in assessment but lack sufficient evidence to be recommended at this time. The use of blood, saliva, or cerebrospinal fluid biomarkers has also received recent attention, but at this time have insufficient evidence and are not recommended in the management or diagnosis of concussion.

Management
Though concussion management is often a multidisciplinary effort, the team physician must remain abreast of current treatment recommendations to appropriately counsel athletes and their families and to ensure that players are appropriately returned to play.

Removal from play and protection from injury is the first and perhaps most important step of concussion management. Athletes that continue to play after concussion are
more likely to have worse symptoms, worse neurocognitive scores, and higher likelihood of prolonged recovery, even without an identified secondary injury. Those with a second injury within 24 hours are also more likely to have greater symptom burden and longer recovery. In addition to a worse recovery trajectory, the risk of devastating neurologic injury such as Second Impact Syndrome (SIS) remains a critical concern in premature return to play of a concussed athlete. Though rare and variably defined, SIS encompasses a clinical presentation of progressive cerebral edema, catastrophic brain injury, with severe disability and possible death, resulting from consecutive concussive events in rapid succession in a player returning to play with ongoing symptoms and incomplete recovery from the initial injury.

Once safely removed from play, the early management of concussion includes brief physical and cognitive rest as well as educating the athlete and family on expectations for recovery. Most concussions resolve quickly. In high school and collegiate athletes, 80–90% resolve within 2 weeks, while younger patients may experience longer recoveries, most resolve within 4 weeks. Symptoms lasting longer than 4 weeks are considered prolonged and often termed Persistent Post-Concussion Symptoms (PPCS). It is recognized that persistent symptoms may not reflect a single pathophysiologic syndrome or ongoing injury to the brain but rather represents a collection of nonspecific symptoms that may include confounding or co-existing factors. Greater severity of both acute and subacute symptoms remains the strongest predictor of prolonged recovery. Pre-existing history or subacute development of headaches and mental health concerns, especially depression, increases the risk of symptoms greater than 1 month.

Though prior recommendations focused on significant rest in the form of no physical or cognitive activity until full symptom resolution, there is a growing body of evidence supporting the safety of early and gradual return to both academics and exercise. Indeed, prolonged

‘dark room’ or ‘cocoon therapy’ may prolong recovery.\textsuperscript{3} Current recommendations suggest a brief period (24–48 hours) of rest, followed by progressing “sub-threshold” cognitive and physical activity that does not significantly worsen symptoms.\textsuperscript{2}

\textbf{Return to Learn}

Concussion may induce cognitive symptoms including alterations in attention, processing, and memory that can be further exacerbated by headaches, fatigue, and sleep disturbance.\textsuperscript{3} Brief cognitive rest and a progressive return to school as tolerated without substantially worsening symptoms does not appear to prolong recovery and may reduce social isolation and stress associated with academic setback.\textsuperscript{26} The lights and noise of the school setting and increased screen exposure of remote learning both have the potential to worsen concussion symptoms.\textsuperscript{27} It is important to reassure the athlete, family, and school that elevated symptoms do not represent ongoing brain injury and students with minimal or resolved symptoms may safely return to all levels of academics as soon as tolerated. Students with severe or prolonged symptoms may require extended accommodations and should be provided an individualized return to learn protocol (Table 2). Recommendations for return to learning is available through the American Academy of Pediatrics (AAP),\textsuperscript{27} and resources for students, families, and schools are available online through the Center for Disease Control and Prevention (CDC).\textsuperscript{28}

\textbf{Return to Sport}

Early introduction of light, “sub-threshold” exercise that is tolerated without substantially increasing symptoms has evidence of safety to the brain and may benefit mood, sleep patterns, overall symptom burden, and hasten recovery.\textsuperscript{29,30} Prior to return to competition,
concussed athletes should be progressed through a formal return-to-play (RTP) protocol, demonstrating symptom-free tolerance of progressive sport-specific activity prior to clearance for contact or collision risk (Table 3).2,3 Each step in the progression requires a minimum of 24 hours so that asymptomatic athletes should require a minimum of just under a week before being returned to competition.2 For athletes with prior concussions or prolonged recovery, a slower progressive return to play may be appropriate.5 RTP protocols, especially in prolonged or complicated recoveries, are ideally guided by an athletic trainer and physician with experience in concussion management.5

**Pharmacologic Treatment**

The underlying pathophysiology of concussion is predominantly self-resolving, and no medication is FDA-cleared for direct treatment of concussion. Nonsteroidal anti-inflammatories (NSAIDs) and acetaminophen are commonly utilized for headaches, though both have potential for rebound or overuse headaches with chronic use in as little as 2 weeks with three times or more per week use.5 For prolonged symptoms, targeted medication use for sleep, headaches/migraines, cognitive deficits, and concentration difficulties are frequently utilized by PCPs and specialists but should be reserved for severe cases and guided by clinicians experienced in advanced concussion management.31

**Targeted Therapies**

Physical therapy can be extremely beneficial in acute and prolonged concussion symptoms. As cervical injuries and neck pain frequently accompany concussion and can contribute to ongoing headaches, therapy for cervicalgia may hasten recovery.32 Vestibular therapy for patients with associated oculomotor and vestibular symptoms may decrease symptomatology and help guide progressive increase in exercise and academics, especially in those with persisting vestibular-oculomotor deficits and symptoms.3,32 If mood disturbances including anxiety and depression present as a prominent symptom after concussion, either as new symptoms or exacerbation of a pre-existing condition, focused standard of care therapies aimed at these symptoms can be extremely helpful.1,12

### Table 3. Graduated Return to Sport (RTS) Strategy

<table>
<thead>
<tr>
<th>Stage</th>
<th>Aim</th>
<th>Activity</th>
<th>Goals of Each Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Symptom-limited activity</td>
<td>Daily activities that do not provoke symptoms</td>
<td>Gradual reintroduction of work/school activities</td>
</tr>
<tr>
<td>2</td>
<td>Light aerobic exercise</td>
<td>Walking or stationary cycling at slow to medium pace. No resistance training</td>
<td>Increase heart rate</td>
</tr>
<tr>
<td>3</td>
<td>Sport-specific exercise</td>
<td>Running or skating drills. No head impact activities</td>
<td>Add movement</td>
</tr>
<tr>
<td>4</td>
<td>Non-contact training drills</td>
<td>Harder training drills, e.g., passing drills. May start progressive resistance training</td>
<td>Exercise, coordination, and increased thinking</td>
</tr>
<tr>
<td>5</td>
<td>Full contact practice</td>
<td>Following medical clearance, participate in normal training activities</td>
<td>Restore confidence and assess functional skills by coaching staff</td>
</tr>
<tr>
<td>6</td>
<td>Return to sport</td>
<td>Normal game play</td>
<td></td>
</tr>
</tbody>
</table>

Legislation
All 50 states and the District of Columbia have legislation regarding sport-related concussion that may vary in detail—overseeing removal from play, educational requirements for coaches, parents, athletes, and healthcare professionals, return-to-learn policies, and the medical credentials and training required for providing clearance for an athlete to return to play. It is imperative that all team physicians be aware of state laws and regulations surrounding concussion management.

Long-Term Sequelae
Included in the most recent CISG consensus statement is a systematic review of possible long-term sequelae of concussion.33 Athletes with any neuropsychiatric symptoms potentially attributable to concussions should always be appropriately evaluated and referred for comorbid, treatable conditions.5

Chronic Traumatic Encephalopathy (CTE)
Perhaps the most attention has been given to CTE, a distinct tauopathy studied primarily in active and former contact and collision athletes. More research is needed to assess the prevalence of CTE in both athletes and the general population to determine any potential relationship between neuropathological findings and symptoms to better understand the progressive nature of CTE pathology and to identify any additional risk or protective factors for the condition.3,33

Retirement/Disqualification from Sport
There are no current evidence-based criteria for retirement, nor a universally accepted number of concussions prohibiting ongoing participation in higher risk sports.3,5 Any discussion on retirement or disqualification should involve shared decision-making among the athlete, family, and a specialist with expertise in concussion management.3,5

Prevention
Historically, prevention of concussion has been focused primarily on protective equipment, rule changes and enforcement, neck strengthening, and education. Advances in personal protective equipment have been a consistent focus, however, while critical in prevention of structural injuries, there is no significant evidence that helmets, headgear, mouth guards, or other protective equipment help in the actual prevention of concussion.5 Changing rules to minimize high-risk situations and maximizing enforcement of protective rules may reduce concussion rates.2,5 Limiting contact in practices, changing tackling or collision techniques, and raising the age of introduction of tackling and checking all have the potential to decrease head contacts, exposure, and possibly concussion risk.2 Neck and shoulder strengthening may also prevent injury, as progressive neck strength is associated with a progressive decrease risk of concussion.36

Summary
Concussions are a common injury that the team orthopaedic surgeon should be familiar with. Standardized assessment tools are helpful in initial and ongoing athlete assessment, but sport-related concussion remains a clinical diagnosis that rarely requires neuroimaging. Athletes with suspicion of concussion should be removed from play pending a complete evaluation and a formal clearance for return to play is required, often guided by state regulations that the covering physician should be aware of. Sport-related concussions typically resolve quickly, and growing evidence supports early return to cognitive and physical activity as tolerated by symptoms. While complete management of sport-related concussion is typically a multi-disciplinary effort, the sideline surgeon remains a crucial member of the medical team in the initial assessment and final clearance of the concussed athlete.
References


WHAT IS THE SCAT5?

The SCAT5 is a standardized tool for evaluating concussions designed for use by physicians and licensed healthcare professionals. The SCAT5 cannot be performed correctly in less than 10 minutes.

If you are not a physician or licensed healthcare professional, please use the Concussion Recognition Tool 5 (CRT5). The SCAT5 is to be used for evaluating athletes aged 13 years and older. For children aged 12 years or younger, please use the Child SCAT5.

Preseason SCAT5 baseline testing can be useful for interpreting post-injury test scores, but is not required for that purpose. Detailed instructions for use of the SCAT5 are provided on page 7. Please read through these instructions carefully before testing the athlete. Brief verbal instructions for each test are given in italics. The only equipment required for the tester is a watch or timer.

This tool may be freely copied in its current form for distribution to individuals, teams, groups, and organizations. It should not be altered in any way, re-branded or sold for commercial gain. Any revision, translation or reproduction in a digital form requires specific approval by the Concussion in Sport Group.

Recognise and Remove

A head impact by either a direct blow or indirect transmission of force can be associated with a serious and potentially fatal brain injury. If there are significant concerns, including any of the red flags listed in Box 1, then activation of emergency procedures and urgent transport to the nearest hospital should be arranged.

Key points

- Any athlete with suspected concussion should be REMOVED FROM PLAY, medically assessed and monitored for deterioration. No athlete diagnosed with concussion should be returned to play on the day of injury.
- If an athlete is suspected of having a concussion and medical personnel are not immediately available, the athlete should be referred to a medical facility for urgent assessment.
- Athletes with suspected concussion should not drink alcohol, use recreational drugs and should not drive a motor vehicle until cleared to do so by a medical professional.
- Concussion signs and symptoms evolve over time and it is important to consider repeat evaluation in the assessment of concussion.
- The diagnosis of a concussion is a clinical judgment, made by a medical professional. The SCAT5 should NOT be used by itself to make, or exclude, the diagnosis of concussion. An athlete may have a concussion even if their SCAT5 is “normal”.

Remember:

- The basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Do not attempt to move the athlete (other than that required for airway management) unless trained to do so.
- Assessment for a spinal cord injury is a critical part of the initial on-field assessment.
- Do not remove a helmet or any other equipment unless trained to do so safely.
IMMEDIATE OR ON-FIELD ASSESSMENT

The following elements should be assessed for all athletes who are suspected of having a concussion prior to proceeding to the neurocognitive assessment and ideally should be done on-field after the first first aid / emergency care priorities are completed.

If any of the "Red Flags" or observable signs are noted after a direct or indirect blow to the head, the athlete should be immediately and safely removed from participation and evaluated by a physician or licensed healthcare professional.

Consideration of transportation to a medical facility should be at the discretion of the physician or licensed healthcare professional.

The GCS is important as a standard measure for all patients and can be done serially if necessary in the event of deterioration in conscious state. The Maddocks questions and cervical spine exam are critical steps of the immediate assessment; however, these do not need to be done serially.

STEP 1: RED FLAGS

- Neck pain or tenderness
- Double vision
- Weakness or tingling/burning in arms or legs
- Severe or increasing headache
- Seizure or convulsion
- Loss of consciousness
- Deteriorating conscious state
- Vomiting
- Increasingly restless, agitated or combative

STEP 2: OBSERVABLE SIGNS

Witnessed □ Observed on Video □

Lying motionless on the playing surface Y N
Balance / gait difficulties / motor incoordination: stumbling, slow / laboured movements Y N
Disorientation or confusion, or an inability to respond appropriately to questions Y N
Blank or vacant look Y N
Facial injury after head trauma Y N

STEP 3: MEMORY ASSESSMENT

MADDOCKS QUESTIONS

"I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?"

Mark Y for correct answer / N for incorrect

What venue are we at today? Y N
Which half is it now? Y N
Who scored last in this match? Y N
What team did you play last week / game? Y N
Did your team win the last game? Y N

STEP 4: EXAMINATION

GLASGOW COMA SCALE (GCS)

Time of assessment
Date of assessment

Best eye response (E)
No eye opening 1 1 1
Eye opening in response to pain 2 2 2
Eye opening to speech 3 3 3
Eyes opening spontaneously 4 4 4

Best verbal response (V)
No verbal response 1 1 1
Incomprehensible sounds 2 2 2
Inappropriate words 3 3 3
Confused 4 4 4
Oriented 5 5 5

Best motor response (M)
No motor response 1 1 1
Extension to pain 2 2 2
Abnormal flexion to pain 3 3 3
Flexion / Withdrawal to pain 4 4 4
Locализes to pain 5 5 5
Obey commands 6 6 6

Glasgow Coma score (E + V + M)

CERVICAL SPINE ASSESSMENT

Does the athlete report that their neck is pain free at rest? Y N
If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain free movement? Y N
Is the limb strength and sensation normal? Y N

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.
OFFICE OR OFF-FIELD ASSESSMENT

Please note that the neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state.

STEP 1: ATHLETE BACKGROUND

Sport / team / school: ________________________________
Date / time of injury: ________________________________
Years of education completed: __________________________
Age: ________________________________
Gender: M / F / Other
Dominant hand: left / neither / right
How many diagnosed concussions has the athlete had in the past?: ________________________________
When was the most recent concussion?: ________________________________
How long was the recovery (time to being cleared to play) from the most recent concussion?: ________________________________ (days)

Has the athlete ever been:
- Hospitalized for a head injury? Yes No
- Diagnosed / treated for headache disorder or migraines? Yes No
- Diagnosed with a learning disability / dyslexia? Yes No
- Diagnosed with ADD / ADHD? Yes No
- Diagnosed with depression, anxiety or other psychiatric disorder? Yes No

Current medications? If yes, please list:
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read this instruction paragraph out loud then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post injury assessment the athlete should rate their symptoms at this point in time.

Please Check: ☐ Baseline ☐ Post-Injury

Please hand the form to the athlete

<table>
<thead>
<tr>
<th>Symptom</th>
<th>none</th>
<th>mild</th>
<th>moderate</th>
<th>severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>“Pressure in head”</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Neck Pain</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Dizziness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Balance problems</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to light</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to noise</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling slowed down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling like “in a fog”</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>“Don’t feel right”</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty remembering</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fatigue or low energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Confusion</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>More emotional</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Irritability</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sadness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nervous or Anxious</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Trouble falling asleep (if applicable)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Total number of symptoms: of 22
Symptom severity score: of 132
Do your symptoms get worse with physical activity? Y N
Do your symptoms get worse with mental activity? Y N
If 100% is feeling perfectly normal, what percent of normal do you feel?
If not 100%, why?

Please hand form back to examiner
### STEP 3: COGNITIVE SCREENING

**Standardised Assessment of Concussion (SAC)**

#### ORIENTATION

<table>
<thead>
<tr>
<th>Question</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>What month is it?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the date today?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the day of the week?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What year is it?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What time is it right now? (within 1 hour)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Orientation score**

#### IMMEDIATE MEMORY

The Immediate Memory component can be completed using the traditional 5-word per trial list or optionally using 10-words per trial to minimise any ceiling effect. All 3 trials must be administered irrespective of the number correct on the first trial. Administer at the rate of one word per second.

Please choose EITHER the 5 or 10 word list groups and circle the specific word list chosen for this test.

I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order. For Trials 2 & 3: I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

<table>
<thead>
<tr>
<th>List</th>
<th>Alternate 5 word lists</th>
<th>Score (of 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Finger Penny Blanket Lemon Insect</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Candle Paper Sugar Sandwich Wagon</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Baby Monkey Perfume Sunset Wagon</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Elbow Apple Carpet Saddle Bubble</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Jacket Arrow Pepper Cotton Movie</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Dollar Honey Mirror Saddle Anchor</td>
<td></td>
</tr>
</tbody>
</table>

**Immediate Memory Score**

**Time that last trial was completed**

#### CONCENTRATION

**DIGITS BACKWARDS**

Please circle the Digit list chosen (A, B, C, D, E, F). Administer at the rate of one digit per second reading DOWN the selected column.

I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7.

<table>
<thead>
<tr>
<th>Concentration Number Lists (circle one)</th>
<th>List A</th>
<th>List B</th>
<th>List C</th>
<th>List D</th>
<th>List E</th>
<th>List F</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-9-3</td>
<td>5-2-6</td>
<td>1-4-2</td>
<td>Y</td>
<td>N</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6-2-9</td>
<td>4-1-5</td>
<td>6-5-8</td>
<td>Y</td>
<td>N</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3-8-1-4</td>
<td>1-7-9-5</td>
<td>6-8-3-1</td>
<td>Y</td>
<td>N</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>3-2-7-9</td>
<td>4-9-6-8</td>
<td>3-4-8-1</td>
<td>Y</td>
<td>N</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6-2-9-7-1</td>
<td>4-8-5-2-7</td>
<td>4-9-1-5-3</td>
<td>Y</td>
<td>N</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1-5-2-8-6</td>
<td>6-1-8-4-3</td>
<td>6-8-2-5-1</td>
<td>Y</td>
<td>N</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7-1-8-4-6-2</td>
<td>8-3-1-9-6-4</td>
<td>3-7-6-5-1-9</td>
<td>Y</td>
<td>N</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5-3-9-1-4-8</td>
<td>7-2-4-8-5-6</td>
<td>9-2-6-5-1-4</td>
<td>Y</td>
<td>N</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Digits Score:**

#### MONTHS IN REVERSE ORDER

Now tell me the months of the year in reverse order. Start with the last month and go backward. So you’ll say December, November. Go ahead.

<table>
<thead>
<tr>
<th>List</th>
<th>Alternate 10 word lists</th>
<th>Score (of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Finger Penny Blanket Lemon Insect Wagon</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Baby Monkey Perfume Sunset Iron</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Jacket Arrow Pepper Cotton Movie</td>
<td></td>
</tr>
</tbody>
</table>

**Immediate Memory Score**

**Time that last trial was completed**

**Concentration Total Score (Digits + Months)**

**Months Score**
STEP 4: NEUROLOGICAL SCREEN

See the instruction sheet (page 7) for details of test administration and scoring of the tests.

- Can the patient read aloud (e.g., symptom checklist) and follow instructions without difficulty? Y N
- Does the patient have a full range of pain-free PASSIVE cervical spine movement? Y N
- Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision? Y N
- Can the patient perform the finger nose coordination test normally? Y N
- Can the patient perform tandem gait normally? Y N

BALANCE EXAMINATION

Modified Balance Error Scoring System (mBESS) testing

Which foot was tested (i.e., which is the non-dominant foot) □ Left □ Right

Testing surface (hard floor, field, etc.)

Footwear (shoes, barefoot, braces, tape, etc.)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double leg stance</td>
<td>of 10</td>
</tr>
<tr>
<td>Single leg stance (non-dominant foot)</td>
<td>of 10</td>
</tr>
<tr>
<td>Tandem stance (non-dominant foot at the back)</td>
<td>of 10</td>
</tr>
<tr>
<td>Total Errors</td>
<td>of 30</td>
</tr>
</tbody>
</table>

STEP 5: DELAYED RECALL:

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order.

Time Started

Please record each word correctly recalled. Total score equals number of words recalled.

Total number of words recalled accurately: □ of 5 or □ of 10

STEP 6: DECISION

Date & time of assessment:

<table>
<thead>
<tr>
<th>Domain</th>
<th>Date of assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom number (of 22)</td>
<td>of 15</td>
</tr>
<tr>
<td>Symptom severity score (of 132)</td>
<td>of 15</td>
</tr>
<tr>
<td>Orientation (of 5)</td>
<td>of 15</td>
</tr>
<tr>
<td>Immediate memory</td>
<td>of 15</td>
</tr>
<tr>
<td>Concentration (of 5)</td>
<td>of 30</td>
</tr>
<tr>
<td>Neuro exam</td>
<td>Normal Abnormal</td>
</tr>
<tr>
<td>Balance errors (of 30)</td>
<td>Normal Abnormal</td>
</tr>
<tr>
<td>Delayed Recall</td>
<td>of 5</td>
</tr>
</tbody>
</table>

Date and time of injury: ________________

If the athlete is known to you prior to their injury, are they different from their usual self? □ Yes □ No □ Unsure □ Not Applicable

Concussion Diagnosed? □ Yes □ No □ Unsure □ Not Applicable

If re-testing, has the athlete improved? □ Yes □ No □ Unsure □ Not Applicable

I am a physician or licensed healthcare professional and I have personally administered or supervised the administration of this SCAT5.

Signature: ____________________________

Name: ________________________________

Title: ________________________________

Registration number (if applicable): __________________

Date: ________________________________

SCORING ON THE SCAT5 SHOULD NOT BE USED AS A STAND-ALONE METHOD TO DIAGNOSE CONCUSSION, MEASURE RECOVERY OR MAKE DECISIONS ABOUT AN ATHLETE’S READINESS TO RETURN TO COMPETITION AFTER CONCUSSION.
CLINICAL NOTES:

Name:__________________________________________

DOB:___________________________________________

Address:________________________________________

ID number:______________________________________

Examiner:_______________________________________

Date:___________________________________________


CONCUSSION INJURY ADVICE

(To be given to the person monitoring the concussed athlete)

This patient has received an injury to the head. A careful medical examination has been carried out and no sign of any serious complications has been found. Recovery time is variable across individuals and the patient will need monitoring for a further period by a responsible adult. Your treating physician will provide guidance as to this timeframe.

If you notice any change in behaviour, vomiting, worsening headache, double vision or excessive drowsiness, please telephone your doctor or the nearest hospital emergency department immediately.

Other important points:

Initial rest: Limit physical activity to routine daily activities (avoid exercise, training, sports) and limit activities such as school, work, and screen time to a level that does not worsen symptoms.

1) Avoid alcohol

2) Avoid prescription or non-prescription drugs without medical supervision. Specifically:
   a) Avoid sleeping tablets
   b) Do not use aspirin, anti-inflammatory medication or stronger pain medications such as narcotics

3) Do not drive until cleared by a healthcare professional.

4) Return to play/sport requires clearance by a healthcare professional.

Clinic phone number:_____________________________

Patient’s name:________________________________

Date / time of injury:_____________________________

Date / time of medical review:_______________________

Healthcare Provider:________________________________

© Concussion in Sport Group 2017
INSTRUCTIONS

Words in Italic throughout the SCAT5 are the instructions given to the athlete by the clinician

Symptom Scale
The time frame for symptoms should be based on the type of test being administered. At baseline it is advantageous to assess how an athlete “typically” feels whereas during the acute/post-acute stage it is best to ask how the athlete feels at the time of testing.

The symptom scale should be completed by the athlete, not by the examiner. In situations where the symptom scale is being completed after exercise, it should be done in a resting state, generally by approximating his/her resting heart rate.

For total number of symptoms, maximum possible is 22 except immediately post injury, if sleep item is omitted, which then creates a maximum of 21.

For Symptom severity score, add all scores in table, maximum possible is 22 x 6 = 132, except immediately post injury if sleep item is omitted, which then creates a maximum of 21x6=126.

Immediate Memory
The Immediate Memory component can be completed using the traditional 5-word per trial list or, optionally, using 10-words per trial. The literature suggests that the Immediate Memory has a notable ceiling effect when a 5-word list is used. In settings where this ceiling is prominent, the examiner may wish to make the task more difficult by incorporating two 5-word groups for a total of 10 words per trial. In this case, the maximum score per trial is 10 with a total trial maximum of 30.

Choose one of the word lists (either 5 or 10). Then perform 3 trials of immediate memory using this list.

Complete all 3 trials regardless of score on previous trials.

“I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order. "The words must be read at a rate of one word per second.

Trials 2 & 3 MUST be completed regardless of score on trial 1 & 2.

Trials 2 & 3:
"I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

Score 1 pt. for each correct response. Total score equals sum across all 3 trials. Do NOT inform the athlete that delayed recall will be tested.

Concentration
Digits backward
Choose one column of digits from lists A, B, C, D, E or F and administer those digits as follows:

Say: “I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7.”

Begin with first 3 digit string.

If correct, circle “Y” for correct and go to next string length. If incorrect, circle “N” for the first string length and read trial 2 in the same string length. One point possible for each string length. Stop after incorrect on both trials (2 N’s) in a string length.

The digits should be read at the rate of one per second.

Months in reverse order

“Now tell me the months of the year in reverse order. Start with the last month and go backward. So you’ll say December, November... Go ahead”

1 pt. for entire sequence correct

Delayed Recall
The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section.

“Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order.”

Score 1 pt. for each correct response

Modified Balance Error Scoring System (mBEss)® testing
This balance testing is based on a modified version of the Balance Error Scoring System (BEss)®. A timing device is required for this testing.

Each of 20-second trial/stance is scored by counting the number of errors. The examiner will begin counting errors only after the athlete has assumed the proper start position. The modified BESS is calculated by adding one error point for each error during the three 20-second tests. The maximum number of errors for any single condition is 10. If the athlete commits multiple errors simultaneously, only one error is recorded but the athlete should quickly return to the testing position, and counting should resume once the athlete is set. Athletes that are unable to maintain the testing procedure for a minimum of five seconds at the start are assigned the highest possible score, ten, for that testing condition.

OPTION: For further assessment, the same 3 stances can be performed on a surface of medium density foam (e.g., approximately 50cm x 40cm x 6cm).

Balance testing – types of errors

1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting foot or heel position > 5 sec
6. Remaining out of test

“I am now going to test your balance. Please take your shoes off (if applicable), roll up your pant legs above ankle (if applicable), and remove any ankle taping (if applicable). This test will consist of three twenty second tests with different stances.”

(a) Double leg stance:

“The first stance is standing with your feet together with your hands on your hips and with your eyes closed. You should try to maintain stability in that position for 20 seconds. I will be counting the number of times you move out of this position. I will start timing when you are set and have closed your eyes.”

(b) Single leg stance:

“If you were to kick a ball, which foot would you use? [This will be the dominant foot] Now stand on your non-dominant foot. The dominant leg should be held in approximately 30 degrees of hip flexion and 45 degrees of knee flexion. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes.”

(c) Tandem stance:

“Now stand heel-to-toe with your non-dominant foot in back. Your weight should be evenly distributed across both feet. Again, you should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes.”

Tandem Gait
Participants are instructed to stand with their feet together behind a starting line (the test is best done with footwear removed). Then, they walk in a forward direction as quickly and as accurately as possible along a 38mm wide (sports tape), 3 metre line with an alternate foot heel-to-toe gait ensuring that they approximate their heel and toe on each step. Once they cross the end of the 3m line, they turn 180 degrees and return to the starting point using the same gait. Athletes fail the test if they step off the line, have a separation between their heel and toe, or if they touch or grab the examiner or an object.

Finger to Nose

“I am going to test your coordination now. Please sit comfortably on the chair with your eyes open and your arm (either right or left) outstretched (shoulder flexed to 90 degrees and elbow and fingers extended), pointing in front of you. When I give a start signal, I would like you to perform five successive finger to nose repetitions using your index finger to touch the tip of the nose, and then return to the starting position, as quickly and as accurately as possible.”

References

CONCUSSION INFORMATION

Any athlete suspected of having a concussion should be removed from play and seek medical evaluation.

Signs to watch for

Problems could arise over the first 24-48 hours. The athlete should not be left alone and must go to a hospital at once if they experience:

• Worsening headache
• Drowsiness or inability to be awakened
• Inability to recognize people or places
• Repeated vomiting
• Unusual behaviour or confusion or irritable
• Seizures (arms and legs jerk uncontrollably)
• Weakness or numbness in arms or legs
• Unsteadiness on their feet.
• Slurred speech

Consult your physician or licensed healthcare professional after a suspected concussion. Remember, it is better to be safe.

Rest & Rehabilitation

After a concussion, the athlete should have physical rest and relative cognitive rest for a few days to allow their symptoms to improve. In most cases, after no more than a few days of rest, the athlete should gradually increase their daily activity level as long as their symptoms do not worsen. Once the athlete is able to complete their usual daily activities without concussion-related symptoms, the second step of the return to play/sport progression can be started. The athlete should not return to play/sport until their concussion-related symptoms have resolved and the athlete has successfully returned to full school/learning activities.

When returning to play/sport, the athlete should follow a stepwise, medically managed exercise progression, with increasing amounts of exercise. For example:

Graduated Return to Sport Strategy

<table>
<thead>
<tr>
<th>Exercise step</th>
<th>Functional exercise at each step</th>
<th>Goal of each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Symptom-limited activity</td>
<td>Daily activities that do not give the athlete symptoms</td>
<td>Gradual reintroduction of work/school activities.</td>
</tr>
<tr>
<td>2. Light aerobic exercise</td>
<td>Walking or stationary cycling at slow to medium pace. No resistance training.</td>
<td>Increase heart rate.</td>
</tr>
<tr>
<td>4. Non-contact training drills</td>
<td>Harder training drills, e.g., passing drills. May start progressive resistance training.</td>
<td>Exercise, coordination, and increased thinking.</td>
</tr>
<tr>
<td>5. Full contact practice</td>
<td>Following medical clearance, participate in normal training activities.</td>
<td>Restore confidence and assess functional skills by coaching staff.</td>
</tr>
<tr>
<td>6. Return to play/sport</td>
<td>Normal game play.</td>
<td></td>
</tr>
</tbody>
</table>

In this example, it would be typical to have 24 hours (or longer) for each step of the progression. If any symptoms worsen while exercising, the athlete should go back to the previous step. Resistance training should be added only in the later stages (Stage 3 or 4 at the earliest).

Written clearance should be provided by a healthcare professional before return to play/sport as directed by local laws and regulations.

Graduated Return to School Strategy

Concussion may affect the ability to learn at school. The athlete may need to miss a few days of school after a concussion. When going back to school, some athletes may need to go back gradually and may need to have some changes made to their schedule so that concussion symptoms do not get worse. If a particular activity makes symptoms worse, then the athlete should stop that activity and rest until symptoms get better. To make sure that the athlete can get back to school without problems, it is important that the healthcare provider, parents, caregivers and teachers talk to each other so that everyone knows what the plan is for the athlete to go back to school.

Note: If mental activity does not cause any symptoms, the athlete may be able to skip step 2 and return to school part-time before doing school activities at home first.

<table>
<thead>
<tr>
<th>Mental Activity</th>
<th>Activity at each step</th>
<th>Goal of each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Daily activities that do not give the athlete symptoms</td>
<td>Typical activities that the athlete does during the day as long as they do not increase symptoms (e.g. reading, texting, screen time). Start with 5-15 minutes at a time and gradually build up.</td>
<td>Gradual return to typical activities.</td>
</tr>
<tr>
<td>2. School activities</td>
<td>Homework, reading or other cognitive activities outside of the classroom.</td>
<td>Increase tolerance to cognitive work.</td>
</tr>
<tr>
<td>3. Return to school part-time</td>
<td>Gradual introduction of school work. May need to start with a partial school day or with increased breaks during the day.</td>
<td>Increase academic activities.</td>
</tr>
<tr>
<td>4. Return to school full-time</td>
<td>Gradually progress school activities until a full day can be tolerated.</td>
<td>Return to full academic activities and catch up on missed work.</td>
</tr>
</tbody>
</table>

If the athlete continues to have symptoms with mental activity, some other accommodations that can help with return to school may include:

- Starting school later, only going for half days, or going only to certain classes
- More time to finish assignments/tests
- Quiet room to finish assignments/tests
- Not going to noisy areas like the cafeteria, assembly halls, sporting events, music class, shop class, etc.
- Taking lots of breaks during class, homework, tests
- No more than one exam/day
- Shorter assignments
- Repetition/memory cues
- Use of a student helper/tutor
- Reassurance from teachers that the child will be supported while getting better

The athlete should not go back to sports until they are back to school/learning, without symptoms getting significantly worse and no longer needing any changes to their schedule.
WHAT IS THE CHILD SCAT5?

The Child SCAT5 is a standardized tool for evaluating concussions designed for use by physicians and licensed healthcare professionals.

If you are not a physician or licensed healthcare professional, please use the Concussion Recognition Tool 5 (CRT5). The Child SCAT5 is to be used for evaluating Children aged 5 to 12 years. For athletes aged 13 years and older, please use the SCAT5.

Preseason Child SCAT5 baseline testing can be useful for interpreting post-injury test scores, but not required for that purpose. Detailed instructions for use of the Child SCAT5 are provided on page 7. Please read through these instructions carefully before testing the athlete. Brief verbal instructions for each test are given in italics. The only equipment required for the tester is a watch or timer.

This tool may be freely copied in its current form for distribution to individuals, teams, groups and organizations. It should not be altered in any way, re-branded or sold for commercial gain. Any revision, translation or reproduction in a digital form requires specific approval by the Concussion in Sport Group.

Remember:

- The basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Do not attempt to move the athlete (other than that required for airway management) unless trained to do so.
- Assessment for a spinal cord injury is a critical part of the initial on-field assessment.
- Do not remove a helmet or any other equipment unless trained to do so safely.

Key points

- Any athlete with suspected concussion should be REMOVED FROM PLAY, medically assessed and monitored for deterioration. No athlete diagnosed with concussion should be returned to play on the day of injury.
- If the child is suspected of having a concussion and medical personnel are not immediately available, the child should be referred to a medical facility for urgent assessment.
- Concussion signs and symptoms evolve over time and it is important to consider repeat evaluation in the assessment of concussion.
- The diagnosis of a concussion is a clinical judgment, made by a medical professional. The Child SCAT5 should NOT be used by itself to make, or exclude, the diagnosis of concussion. An athlete may have a a concussion even if their Child SCAT5 is “normal”.

Recognise and Remove

A head impact by either a direct blow or indirect transmission of force can be associated with a serious and potentially fatal brain injury. If there are significant concerns, including any of the red flags listed in Box 1, then activation of emergency procedures and urgent transport to the nearest hospital should be arranged.
**IMMEDIATE OR ON-FIELD ASSESSMENT**

The following elements should be assessed for all athletes who are suspected of having a concussion prior to proceeding to the neurocognitive assessment and ideally should be done on-field after the first first aid / emergency care priorities are completed.

If any of the "Red Flags" or observable signs are noted after a direct or indirect blow to the head, the athlete should be immediately and safely removed from participation and evaluated by a physician or licensed healthcare professional.

Consideration of transportation to a medical facility should be at the discretion of the physician or licensed healthcare professional.

The GCS is an important standard measure for all patients and can be done serially if necessary in the event of deterioration in conscious state. The cervical spine exam is a critical step of the immediate assessment, however, it does not need to be done serially.

**STEP 1: RED FLAGS**

- Neck pain or tenderness
- Double vision
- Weakness or tingling/numbness in arms or legs
- Severe or increasing headache

**STEP 2: OBSERVABLE SIGNS**

Witnessed □  Observed on Video □

<table>
<thead>
<tr>
<th>Lying motionless on the playing surface</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance / gait difficulties / motor incoordination: stumbling, slow / laboured movements</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Disorientation or confusion, or an inability to respond appropriately to questions</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Blank or vacant look</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Facial injury after head trauma</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

**STEP 3: EXAMINATION**

**GLASGOW COMA SCALE (GCS)**

<table>
<thead>
<tr>
<th>Time of assessment</th>
<th>Date of assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best eye response (E)</td>
<td></td>
</tr>
<tr>
<td>No eye opening</td>
<td>1 1 1</td>
</tr>
<tr>
<td>Eye opening in response to pain</td>
<td>2 2 2</td>
</tr>
<tr>
<td>Eye opening to speech</td>
<td>3 3 3</td>
</tr>
<tr>
<td>Eyes opening spontaneously</td>
<td>4 4 4</td>
</tr>
<tr>
<td>Best verbal response (V)</td>
<td></td>
</tr>
<tr>
<td>No verbal response</td>
<td>1 1 1</td>
</tr>
</tbody>
</table>

**CERVICAL SPINE ASSESSMENT**

- Does the athlete report that their neck is pain free at rest? Y N
- If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain free movement? Y N
- Is the limb strength and sensation normal? Y N

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.

**OFFICE OR OFF-FIELD ASSESSMENT**

**STEP 1: ATHLETE BACKGROUND**

Please note that the neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state.

| Sport / team / school: | |
| Date / time of injury: | |
| Years of education completed: | |
| Age: | |
| Gender: M / F / Other | |
| Dominant hand: left / neither / right | |
| How many diagnosed concussions has the athlete had in the past? | |
| When was the most recent concussion? | |
| How long was the recovery (time to being cleared to play) from the most recent concussion?: (days) | |
| Has the athlete ever been: | Yes No |
| Hospitalized for a head injury? | |
| Diagnosed / treated for headache disorder or migraines? | Yes No |
| Diagnosed with a learning disability / dyslexia? | Yes No |
| Diagnosed with ADD / ADHD? | Yes No |
| Diagnosed with depression, anxiety or other psychiatric disorder? | Yes No |
| Current medications? If yes, please list: | |
STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read this instruction paragraph out loud then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post-injury assessment the athlete should rate their symptoms at this point in time.

To be done in a resting state

Please Check: ☐ Baseline ☐ Post-Injury

---

Child Report:

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Not at all/ Never</th>
<th>A little/ Rarely</th>
<th>Somewhat/ Sometimes</th>
<th>A lot/ Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel dizzy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel like the room is spinning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel like I'm going to faint</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Things are blurry when I look at them</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I see double</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel sick to my stomach</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>My neck hurts</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get tired a lot</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get tired easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have trouble paying attention</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get distracted easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have a hard time concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems remembering what people tell me</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems following directions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I daydream too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get confused</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I forget things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems finishing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have trouble figuring things out</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>It's hard for me to learn new things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Total number of symptoms: 21
Symptom severity score: 63

Do the symptoms get worse with physical activity? Y N
Do the symptoms get worse with physical activity? Y N

Overall rating for child to answer:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Very bad</th>
<th>Very good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

If not 10, in what way do you feel different?

---

Parent Report

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Not at all/ Never</th>
<th>A little/ Rarely</th>
<th>Somewhat/ Sometimes</th>
<th>A lot/ Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>has headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feels dizzy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has a feeling that the room is spinning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feels faint</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has blurred vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has double vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>experiences nausea</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has a sore neck</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets tired a lot</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets tired easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has trouble sustaining attention</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>is easily distracted</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has problems remembering what he/she is told</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty following directions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>tends to daydream</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets confused</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>is forgetful</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty completing tasks</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has poor problem solving skills</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has problems learning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Total number of symptoms: 21
Symptom severity score: 63

Do the symptoms get worse with physical activity? Y N
Do the symptoms get worse with mental activity? Y N

Overall rating for parent/teacher/coach/carer to answer

On a scale of 0 to 100% (where 100% is normal), how would you rate the child now?

If not 100, in what way does the child seem different?

---
### STEP 3: COGNITIVE SCREENING

**Standardized Assessment of Concussion - Child Version (SAC-C)**

#### IMMEDIATE MEMORY

The Immediate Memory component can be completed using the traditional 5-word per trial list or optionally using 10-words per trial to minimise any ceiling effect. All 3 trials must be administered irrespective of the number correct on the first trial. Administer at the rate of one word per second.

Please choose EITHER the 5 or 10 word list groups and circle the specific word list chosen for this test.

* I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order. For Trials 2 & 3 I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

<table>
<thead>
<tr>
<th>List</th>
<th>Alternate 5 word lists</th>
<th>Score (of 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Finger Penny Blanket Lemon Insect</td>
<td>Trial 1 Trial 2 Trial 3</td>
</tr>
<tr>
<td>B</td>
<td>Candle Paper Sugar Sandwich Wagon</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Baby Monkey Perfume Sunset Iron</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Elbow Apple Carpet Saddle Bubble</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Jacket Arrow Pepper Cotton Movie</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Dollar Honey Mirror Saddle Anchor</td>
<td></td>
</tr>
</tbody>
</table>

**Immediate Memory Score** of 15

**Time that last trial was completed**

<table>
<thead>
<tr>
<th>List</th>
<th>Alternate 10 word lists</th>
<th>Score (of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Finger Penny Blanket Lemon Insect</td>
<td>Trial 1 Trial 2 Trial 3</td>
</tr>
<tr>
<td></td>
<td>Candle Paper Sugar Sandwich Wagon</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Baby Monkey Perfume Sunset Iron</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Elbow Apple Carpet Saddle Bubble</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jacket Arrow Pepper Cotton Movie</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dollar Honey Mirror Saddle Anchor</td>
<td></td>
</tr>
</tbody>
</table>

**Immediate Memory Score** of 30

**Time that last trial was completed**

### CONCENTRATION

#### DIGITS BACKWARDS

Please circle the Digit list chosen (A, B, C, D, E, F). Administer at the rate of one digit per second reading DOWN the selected column.

* I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7.

<table>
<thead>
<tr>
<th>Concentration Number Lists (circle one)</th>
<th>List A</th>
<th>List B</th>
<th>List C</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-2</td>
<td></td>
<td></td>
<td>Y</td>
</tr>
<tr>
<td>4-1</td>
<td></td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>4-9</td>
<td>4-9</td>
<td>9-4</td>
<td>6-2</td>
</tr>
<tr>
<td>6-9</td>
<td>4-1-5</td>
<td>6-5-8</td>
<td></td>
</tr>
<tr>
<td>3-8</td>
<td>1-7-9</td>
<td>6-8-3</td>
<td></td>
</tr>
<tr>
<td>2-7</td>
<td>6-4-8</td>
<td>3-4-8</td>
<td></td>
</tr>
<tr>
<td>6-2-9-7-1</td>
<td>4-8-5-2</td>
<td>4-9-1-5</td>
<td>3-8-1</td>
</tr>
<tr>
<td>1-5-2-8-6</td>
<td>6-1-8-4</td>
<td>6-8-2-5</td>
<td>1-5-2-8-6</td>
</tr>
<tr>
<td>7-1-8-4-6-2</td>
<td>8-3-1-9-6-4</td>
<td>3-7-6-5-1-9</td>
<td>Y</td>
</tr>
<tr>
<td>5-3-9-1-4-8</td>
<td>7-2-4-8-5-6</td>
<td>9-2-6-5-1-4</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Digits Score:** of 5

### DAYS IN REVERSE ORDER

Now tell me the days of the week in reverse order. Start with the last day and go backward. So you say Sunday, Saturday, go ahead.

<table>
<thead>
<tr>
<th>Sunday</th>
<th>Saturday</th>
<th>Friday</th>
<th>Thursday</th>
<th>Wednesday</th>
<th>Tuesday</th>
<th>Monday</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Days Score:** of 1

**Concentration Total Score (Digits + Days):** of 6
**STEP 4: NEUROLOGICAL SCREEN**

See the instruction sheet (page 7) for details of test administration and scoring of the tests.

<table>
<thead>
<tr>
<th>Test</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can the patient read aloud (e.g. symptom checklist) and follow instructions without difficulty?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the patient have a full range of pain-free PASSIVE cervical spine movement?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can the patient perform the finger nose coordination test normally?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can the patient perform tandem gait normally?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**BALANCE EXAMINATION**

Modified Balance Error Scoring System (BESS) testing

<table>
<thead>
<tr>
<th>Condition</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double leg stance</td>
<td></td>
</tr>
<tr>
<td>Single leg stance (non-dominant foot, 10-12 y/o only)</td>
<td></td>
</tr>
<tr>
<td>Tandem stance (non-dominant foot at back)</td>
<td></td>
</tr>
<tr>
<td>Total Errors</td>
<td></td>
</tr>
</tbody>
</table>

**STEP 5: DELAYED RECALL**

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order.

**STEP 6: DECISION**

<table>
<thead>
<tr>
<th>Domain</th>
<th>Date &amp; time of assessment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom number</td>
<td></td>
</tr>
<tr>
<td>Parent report (of 21)</td>
<td></td>
</tr>
<tr>
<td>Symptom severity score</td>
<td></td>
</tr>
<tr>
<td>Child report (of 63)</td>
<td></td>
</tr>
<tr>
<td>Parent report (of 63)</td>
<td></td>
</tr>
<tr>
<td>Immediate memory</td>
<td></td>
</tr>
<tr>
<td>of 15</td>
<td>of 15</td>
</tr>
<tr>
<td>of 30</td>
<td>of 30</td>
</tr>
<tr>
<td>Concentration (of 6)</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Neuro exam</td>
<td></td>
</tr>
<tr>
<td>Balance errors</td>
<td></td>
</tr>
<tr>
<td>(5-9 y/o of 20)</td>
<td></td>
</tr>
<tr>
<td>(10-12 y/o of 30)</td>
<td></td>
</tr>
<tr>
<td>Delayed Recall</td>
<td></td>
</tr>
<tr>
<td>of 5</td>
<td>of 5</td>
</tr>
<tr>
<td>of 10</td>
<td>of 10</td>
</tr>
</tbody>
</table>

Date and time of injury: ____________________________

If the athlete is known to you prior to their injury, are they different from their usual self?

☐ Yes  ☐ No  ☐ Unsure  ☐ Not Applicable

(If different, describe why in the clinical notes section)

**SCORING ON THE CHILD SCAT5 SHOULD NOT BE USED AS A STAND-ALONE METHOD TO DIAGNOSE CONCUSSION, MEASURE RECOVERY OR MAKE DECISIONS ABOUT AN ATHLETE’S READINESS TO RETURN TO COMPETITION AFTER CONCUSSION.**
For the Neurological Screen (page 5), if the child cannot read, ask him/her to describe what they see in this picture.

**CLINICAL NOTES:**

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

**Concussion injury advice for the child and parents/carergivers**

*(To be given to the person monitoring the concussed child)*

This child has had an injury to the head and needs to be carefully watched for the next 24 hours by a responsible adult.

If you notice any change in behavior, vomiting, dizziness, worsening headache, double vision or excessive drowsiness, please call an ambulance to take the child to hospital immediately.

Other important points:

Following concussion, the child should rest for at least 24 hours.

- The child should not use a computer, internet or play video games if these activities make symptoms worse.
- The child should not be given any medications, including pain killers, unless prescribed by a medical doctor.
- The child should not go back to school until symptoms are improving.
- The child should not go back to sport or play until a doctor gives permission.
INSTRUCTIONS

Words in Italic throughout the Child SCAT5 are the instructions given to the athlete by the clinician.

Symptom Scale

In situations where the symptom scale is being completed after exercise, it should still be done in a resting state, at least 10 minutes post exercise.

At Baseline On the day of injury On all subsequent days
- The child is to complete the Child Report, according to how he/she feels today, and
- The parent/carer is to complete the Parent Report according to how the child has been over the previous week.
- The child is to complete the Child Report, according to how he/she feels now.
- If the parent is present, and has had time to assess the child on the day of injury, the parent completes the Parent Report according to how the child appears now.
- The child is to complete the Child Report, according to how he/she feels today, and
- The parent/carer is to complete the Parent Report according to how the child has been over the previous 24 hours.

For Total number of symptoms, maximum possible is 21
For Symptom severity score, add all scores in table, maximum possible is 21 x 3 = 63

Standardized Assessment of Concussion Child Version (SAC-C)

Immediate Memory

Choose one of the 5-word lists. Then perform 3 trials of immediate memory using this list.

Complete all 3 trials regardless of score on previous trials.

“I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order.” The words must be read at a rate of one word per second.

OPTION: The literature suggests that the Immediate Memory has a notable ceiling effect when a 5-word list is used. (In younger children, use the 5-word list). In settings where this ceiling is prominent the examiner may wish to make the task more difficult by incorporating two 5-word groups for a total of 10 words per trial. In this case the maximum score per trial is 10 with a total maximum of 30 trials.

Trials 2 & 3 MUST be completed regardless of score on trial 1 & 2.

Trials 2 & 3: “I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.”

Score 1 pt. for each correct response. Total score equals sum across all 3 trials. Do NOT inform the athlete that delayed recall will be tested.

Concentration

Digits backward

Choose one column only, from List A, B, C, D, E or F, and administer those digits as follows:

“I am going to read you some numbers and when I am done, you say them back to me backward, in reverse order of how I read them to you. For example, if I say 7-1, you would say 1-7.”

If correct, circle “Y” and go to next string length. If incorrect, circle “N” for the first string length and read trial 2 in the same string length. One point possible for each string length. Stop after incorrect on both trials (2 Ns) in a string length. The digits should be read at the rate of one per second.

Days of the week in reverse order

“Now tell me the days of the week in reverse order. Start with Sunday and go backward. So you’ll say Sunday, Saturday... Go ahead”

1 pt. for entire sequence correct

Delayed Recall

The delayed recall should be performed after at least 5 minutes have elapsed since the end of the Immediate Recall section.

“Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order.”

Circle each word correctly recalled. Total score equals number of words recalled.

Neurological Screen

Reading

The child is asked to read a paragraph of text from the instructions in the Child SCAT5. For children who cannot read, they are asked to describe what they see in a photograph or picture, such as that on page 6 of the Child SCAT5.

Modified Balance Error Scoring System (mBESS) testing

These instructions are to be read by the person administering the Child SCAT5, and each balance task should be demonstrated to the child. The child should then be asked to copy what the examiner demonstrated.

Each of 20-second trial/stance is scored by counting the number of errors. The Balance testing is based on a modified version of the Balance Error Scoring System (BESS).

A stopwatch or watch with a second hand is required for this testing.

“I am now going to test your balance. Please take your shoes off, roll up your pants above your ankle (if applicable), and remove any ankle taping (if applicable). This test will consist of two different parts.”

OPTION: For further assessment, the same 3 stances can be performed on a surface of medium density foam (e.g., approximately 50cm x 40cm x 6cm).

(a) Double leg stance:
The first stance is standing with the feet together with hands on hips and with eyes closed. The child should try to maintain stability in that position for 20 seconds. You should inform the child that you will be counting the number of times the child moves out of this position. You should start timing when the child is set and the eyes are closed.

(b) Tandem stance:
Instruct or show the child how to stand heel-to-toe with the non-dominant foot in the back. Weight should be evenly distributed across both feet. Again, the child should try to maintain stability for 20 seconds with hands on hips and eyes closed. You should inform the child that you will be counting the number of times the child moves out of this position. If the child stumbles out of this position, instruct him/her to open the eyes and return to the start position and continue balancing. You should start timing when the child is set and the eyes are closed.

(c) Single leg stance (10-12 year olds only):
“If you were to kick a ball, which foot would you use? [This will be the dominant foot] Now stand on your other foot. You should bend your other leg and hold it up (show the child). Again, try to stay in that position for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you move out of this position, open your eyes and return to the start position and keep balancing. I will start timing when you are set and have closed your eyes.”

Balance testing – types of errors

1. Hands lifted off iliac crest
2. Moving hips to >30
3. Step, stumble, or fall
4. Moving hips into +30
5. Lifting forefoot or heel degrees abduction
6. Remaining out of test position >5 sec

Each of the 20-second trials is scored by counting the errors, or deviations from the proper stance, accumulated by the child. The examiner will begin counting errors only after the child has assumed the proper start position. The modified BESS is calculated by adding one error point for each error during the 20-second tests. The maximum total number of errors for any single condition is 10. If a child commits multiple errors simultaneously, only one error is recorded but the child should quickly return to the testing position, and counting should resume once subject is set. Children who are unable to maintain the testing procedure for a minimum of five seconds at the start are assigned the highest possible score, ten, for that testing condition.

Tandem Gait

Instruction for the examiner - Demonstrate the following to the child:

The child is instructed to stand with their feet together behind a starting line (the test is best done with footwear removed). Then, they walk in a forward direction as quickly and as accurately as possible along a 3mm wide (sports tape), 3 metre line with an alternate foot heel-to-toe gait ensuring that they approximate their heel and toe on each step. Once they cross the end of the 3m line, they turn 180 degrees and return to the starting point using the same gait. Children fail the test if they step off the line, have separation between their heel and toe, or if they touch or grab the examiner or an object.

Finger to Nose

The tester should demonstrate it to the child.

“I am going to test your coordination now. Please sit comfortably on the chair with your eyes open and your arm (either right or left) outstretched (shoulder flexed to 90 degrees and elbow and fingers extended). When I give a start signal, I would like you to perform five successive finger to nose repetitions using your index finger to touch the tip of the nose as quickly and as accurately as possible.”

Scoring: 5 correct repetitions in ≤ 4 seconds = 1

Note for testers: Children fail the test if they do not touch their nose, do not fully extend their elbow or do not perform five repetitions.

References

CONCUSSION INFORMATION

If you think you or a teammate has a concussion, tell your coach/trainer/parent right away so that you can be taken out of the game. You or your teammate should be seen by a doctor as soon as possible. YOU OR YOUR TEAMMATE SHOULD NOT GO BACK TO PLAY/SPORT THAT DAY.

Signs to watch for

Problems can happen over the first 24-48 hours. You or your teammate should not be left alone and must go to a hospital right away if any of the following happens:

- New headache, or headache gets worse
- Neck pain that gets worse
- Becomes sleepy/drowsy or can’t be woken up
- Cannot recognize people or places
- Feeling sick to your stomach or vomiting
- Has weakness, numbness or tingling (arms, legs or face)
- Is unsteady walking or standing
- Talking is slurred
- Cannot understand what someone is saying or directions
- Unusual behavior
- New memory problems
- Is unsteady walking or standing
- Cannot recognize people or places
- New or worsening headache
- Sensitivity to light or sounds
- Nausea or vomiting
- Dizziness
- Not going to noisy areas
- Feeling sick to your stomach or vomiting
- Headache gets worse

Consult your physician or licensed healthcare professional after a suspected concussion. Remember, it is better to be safe.

Graduated Return to Sport Strategy

After a concussion, the child should rest physically and mentally for a few days to allow symptoms to get better. In most cases, after a few days of rest, they can gradually increase their daily activity level as long as symptoms don’t get worse. Once they are able to do their usual daily activities without symptoms, the child should gradually increase exercise in steps, guided by the healthcare professional (see below).

The athlete should not return to play/sport the day of injury.

NOTE: An initial period of a few days of both cognitive (“thinking”) and physical rest is recommended before beginning the Return to Sport progression.

Graduated Return to School Strategy

Concussion may affect the ability to learn at school. The child may need to miss a few days of school after a concussion, but the child’s doctor should help them get back to school after a few days. When going back to school, some children may need to go back gradually and may need to have some changes made to their schedule so that concussion symptoms don’t get a lot worse. If a particular activity makes symptoms a lot worse, then the child should stop that activity and rest until symptoms get better.

To make sure that the child can get back to school without problems, it is important that the health care provider, parents/caregivers and teachers talk to each other so that everyone knows what the plan is for the child to go back to school.

Note: If mental activity does not cause any symptoms, the child may be able to return to school part-time without doing school activities at home first.

<table>
<thead>
<tr>
<th>Mental Activity</th>
<th>Activity at each step</th>
<th>Goal of each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Daily activities that do not give the child symptoms</td>
<td>Typical activities that the child does during the day as long as they do not increase symptoms (e.g. reading, texting, screen time). Start with 5-15 minutes at a time and gradually build up.</td>
<td>Gradual return to typical activities.</td>
</tr>
<tr>
<td>2. School activities</td>
<td>Homework, reading or other cognitive activities outside of the classroom.</td>
<td>Increase tolerance to cognitive work.</td>
</tr>
<tr>
<td>3. Return to school part-time</td>
<td>Gradual introduction of schoolwork. May need to start with a partial school day or with increased breaks during the day.</td>
<td>Increase academic activities.</td>
</tr>
<tr>
<td>4. Return to school full-time</td>
<td>Gradually progress school activities until a full day can be tolerated.</td>
<td>Return to full academic activities and catch up on missed work.</td>
</tr>
</tbody>
</table>

If the child continues to have symptoms with mental activity, some other things that can be done to help with return to school may include:

- Taking lots of breaks during class, homework, tests
- No more than one exam/day
- Shorter assignments
- Repetition/memory cues
- Use of a student helper/tutor
- Reassurance from teachers that the child will be supported while getting better

The child should not go back to sports until they are back to school/learning, without symptoms getting significantly worse and no longer needing any changes to their schedule.

There should be at least 24 hours (or longer) for each step of the progression. If any symptoms worsen while exercising, the athlete should go back to the previous step. Resistance training should be added only in the later stages (Stage 3 or 4 at the earliest). The athlete should not return to sport until the concussion symptoms have gone, they have successfully returned to full school/learning activities, and the healthcare professional has given the child written permission to return to sport.

If the child has symptoms for more than a month, they should ask to be referred to a healthcare professional who is an expert in the management of concussion.